STATEMENT OF THE CLAIMS

1. (currently amended) An orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system, comprising:

a hub including a hub receiver and a hub transmitter; and

a plurality of nodes each having a node receiver and a node transmitter, each said node transmitter for transmitting data over a unique group of carriers at the same time, wherein

said hub includes a fast Fourier transform (FFT) which converts data transmitted by said node transmitters over said carriers and received by said hub receiver into a frequency domain,

said hub includes decision means coupled to said FFT for determining quadrature components X_{dkn} and Y_{dkn} of a decision vector from received vector outputs X_{kn}, Y_{kn} of said FFT, where n is an index of OFDM symbols and k is an index of said carriers,

said hub receiver is adapted to receive said data from each of said node transmitters and said hub is adapted to use said data to derive a frequency offset estimation for each node transmitter and to send an indication of each said frequency offset estimation to said nodes,

said frequency offset estimation is conducted in said frequency domain, and

said node receivers are adapted to receive said indication, and said node is adapted to modify data for transmission based at least partially on said indication.

2. (canceled)

3. (canceled)

4. (currently amended) A system according to claim ~~3~~ 1, wherein:

said hub includes means for calculating differential quadrature components dX_{kn}, dY_{kn} where $dX_{kn} = (X_{kn} - X_{dkn})$ and $dY_{kn} = (Y_{kn} - Y_{dkn})$.

5. (original) A system according to claim 4, wherein:

said hub includes means for reducing said differential quadrature components to obtain reduced differential components dX_{rkn} and dY_{rkn} according to

$dX_{rkn} = (A_0/A_{kn})(dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})$, and

$dY_{rkn} = (A_0/A_{kn})(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$,

where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

6. (currently amended) A system according to claim 5, wherein:

said hub includes means for averaging reduced differential components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$dX_r = (1/KN)\sum dX_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N}(dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})/A_k$$

$$dY_r = (1/KN)\sum dY_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N}(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

7. (original) A system according to claim 6, wherein:

N is chosen such that KN is a desired value.

8. (original) A system according to claim 7, wherein:

KN is chosen to be at least 50.

9. (original) A system according to claim 6, wherein:

said hub includes means for generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

10. (original) A system according to claim 9, wherein:

said means for generating an indication includes means for estimating phase shift for each carrier group according to

$\mathrm{Sin}\phi = [dX_rY_0 - dY_rX_0]/A$, and $\mathrm{Cos}\phi = [(A_0)^2 + dX_rX_0 + dY_rY_0]/A$ where ϕ is said phase shift, and $A = A_0*[(X_0+dX_r)^2 + (Y_0+dY_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

11. (original) A system according to claim 10, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

12. (original) A system according to claim 10, wherein:

said indication is a function of $\mathrm{Sin}\phi$ and $\mathrm{Cos}\phi$.

13. (original) A system according to claim 12, wherein:

said indication is one of ϕ and Δf where $\Delta f = \phi/2\pi T$.

14. (currently amended) A system according to claim ~~3~~ 1, wherein:

said hub includes means for reducing said quadrature components to obtain reduced quadrature components dX_{rkn} and dY_{rkn} according to $X_{rkn} = (A_0/A_{kn})(X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})$,

$Y_{rkn} = (A_0/A_{kn})(Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$

where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

15. (currently amended) A system according to claim 14, wherein:

said hub includes means for averaging reduced quadrature components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$X_r = (1/KN)\sum X_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})/A_{kn}$$

$$Y_r = (1/KN)\sum Y_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

16. (original) A system according to claim 15, wherein:

N is chosen such that KN is a desired value.

17. (original) A system according to claim 16, wherein:

KN is chosen to be at least 50.

18. (original) A system according to claim 15, wherein:

said hub includes means for generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

19. (original) A system according to claim 18, wherein:

said means for generating an indication includes means for estimating phase shift for each carrier group according to

$\mathrm{Sin}\phi = [X_r Y_0 - Y_r X_0]/A$, and $\mathrm{Cos}\phi = [X_r X_0 + Y_r Y_0]/A$

where ϕ is said phase shift, and $A = A_0 * [(X_r)^2 + (Y_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

20. (original) A system according to claim 19, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

21. (original) A system according to claim 4, wherein:

said hub includes means for reducing said differential quadrature components to obtain reduced differential components dY_{rkn} according to $dY_{rkn} = (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

22. (original) A system according to claim 21, wherein:

said hub includes means for accumulating signs of the reduced components for each said carrier group.

23. (original) A system according to claim 22, wherein:

said means for accumulating signs accumulates said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N} \text{Sign}\ (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and its sign determines a direction for frequency offset adjustment.

24. (original) A system according to claim 23, wherein:

N is chosen such that KN is a desired value.

25. (original) A system according to claim 24, wherein:

KN is chosen to be at least 50.

26. (original) A system according to claim 23, wherein:

said hub further includes means for comparing said D_{+-} to a predetermined threshold value T_d.

27. (original) A system according to claim 26, wherein:

said hub includes means for determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

28. (original) A system according to claim 26, wherein:

said hub includes means for determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\left[\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\left(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn}\right)\right].$$

29. (currently amended) A system according to claim ~~3~~ 1, wherein:

said hub includes means for reducing said quadrature components to obtain reduced quadrature components Y_{rkn} according to $Y_{rkn} = (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

30. (original) A system according to claim 29, wherein:

said hub includes means for accumulating signs of the reduced components for each said carrier group.

31. (original) A system according to claim 30, wherein:

said means for accumulating signs accumulates said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N} \text{Sign}\ (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and its sign determines a direction for frequency offset adjustment.

32. (original) A system according to claim 31, wherein:

N is chosen such that KN is a desired value.

33. (original) A system according to claim 32, wherein:

KN is chosen to be at least 50.

34. (original) A system according to claim 29, wherein:

said hub further includes means for comparing said D_{+-} to a predetermined threshold value T_d.

35. (original) A system according to claim 34, wherein:

said hub includes means for determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

36. (original) A system according to claim 34, wherein:

said hub includes means for determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\ [\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\ (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})].$$

37. (canceled)

38. (canceled)

39. (canceled)

40. (currently amended) A<u>n orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless</u>

telecommunications system, ~~according to claim 39, wherein~~ comprising:

a hub including a hub receiver and a hub transmitter; and

a plurality of nodes each including an inverse fast Fourier transform (IFFT) and a signal correction means coupled to said IFFT for frequency offset compensation of data signals applied to and processed by said IFFT and each said node having a node receiver and a node transmitter, each said node transmitter for transmitting data over a unique group of carriers at the same time, wherein

said hub receiver is adapted to receive said data from each of said node transmitters and said hub is adapted to use said data to derive a frequency offset estimation for each node transmitter and to send an indication of each said frequency offset estimation to said nodes,

said signal correction means corrects a data signal according to $X_{mc} = X_m\cos(m\phi) + Y_m\sin(m\phi)$, $Y_{mc} = Y_m\cos(m\phi) - X_m\sin(m\phi)$, where X_m and Y_m are respectively real and imaginary parts of an m-th complex sample of said signal at an output of said IFFT after processing by said IFFT, where m is an integer changing from 1 to M, and M is the number of carriers in said multicarrier system, X_{mc} and Y_{mc} are respectively real and

imaginary parts of the m-th corrected sample, and ϕ is a function of said indication of said frequency offset estimation sent by said hub to said node, and

said node receivers are adapted to receive said indication, and said node is adapted to modify data for transmission based at least partially on said indication.

41. (original) A system according to claim 40, wherein:

each said node includes means for calculating a product $m\phi$ and a table which provides $\cos(m\phi)$ and $\sin(m\phi)$ values to said signal correction means in response to said means for calculating a product $m\phi$.

42. (original) A system according to claim 40, wherein:

said indication of said frequency offset estimation sent by said hub to said node is one of phase ϕ and a function of a change in frequency Δf where $\phi = 2\pi\Delta fT$ and where T is an FFT interval.

43. (canceled)

44. (canceled)

45. (canceled)

46. (currently amended) A hub for an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system, ~~according to claim 45, wherein~~ comprising:

a hub receiver for receiving data from a plurality of nodes with each node sending said data over a unique group of carriers at the same time; and

a hub transmitter for sending a separate frequency offset estimation for each node, wherein

said hub includes means for utilizing said data to derive each said separate frequency offset estimation,

said hub includes a fast Fourier transform (FFT) which converts said data into a frequency domain, and

said means for utilizing said data conducts a frequency offset estimation in said frequency domain, and includes decision means coupled to said FFT for determining quadrature components X_{dkn} and Y_{dkn} of a decision vector from received vector outputs X_{kn}, Y_{kn} of said FFT, where n is an index of OFDM symbols and k is an index of said carriers.

47. (original) A hub according to claim 46, wherein:

said means for utilizing said data includes means for calculating differential quadrature components dX_{kn}, dY_{kn} where $dX_{kn} = (X_{kn} - X_{dkn})$ and $dY_{kn} = (Y_{kn} - Y_{dkn})$.

48. (original) A hub according to claim 47, wherein:

said means for utilizing said data includes means for reducing said differential quadrature components to obtain reduced differential components dX_{rkn} and dY_{rkn} according to

$dX_{rkn} = (A_0/A_{kn})(dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})$, and

$dY_{rkn} = (A_0/A_{kn})(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$,

where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

49. (currently amended) A hub according to claim 48, wherein:

said means for utilizing said data includes means for averaging reduced differential components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$dX_r = (1/KN)\sum dX_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N}(dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})/A_k$$

$$dY_r = (1/KN)\sum dY_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N}(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

50. (original) A hub according to claim 49, wherein:

N is chosen such that KN is a desired value.

51. (original) A hub according to claim 50, wherein:

KN is chosen to be at least 50.

52. (original) A hub according to claim 49, wherein:

said means for utilizing said data includes means for generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

53. (original) A hub according to claim 52, wherein:

said means for generating an indication includes means for estimating phase shift for each carrier group according to

$\mathrm{Sin}\phi = [dX_rY_0 - dY_rX_0]/A$, and $\mathrm{Cos}\phi = [(A_0)^2 + dX_rX_0 + dY_rY_0]/A$

where ϕ is said phase shift, and $A = A_0*[(X_0+dX_r)^2 + (Y_0+dY_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

54. (original) A hub according to claim 53, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

55. (original) A hub according to claim 54, wherein:

said indication is a function of $\mathrm{Sin}\phi$ and $\mathrm{Cos}\phi$.

56. (currently amended) A hub according to claim 5<u>5</u>, wherein:

said indication is one of ϕ and Δf where $\Delta f = \phi/2\pi T$.

57. (original) A hub according to claim 46, wherein:

said means for utilizing said data includes means for reducing said quadrature components to obtain reduced quadrature components dX_{rkn} and dY_{rkn} according to $X_{rkn} = (A_0/A_{kn})(X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})$, $Y_{rkn} = (A_0/A_{kn})(Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

58. (currently amended) A hub according to claim 57, wherein:

said means for utilizing said data includes means for averaging reduced quadrature components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$X_r = (1/KN)\sum X_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})/A_{kn}$$

$$Y_r = (1/KN)\sum Y_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

59. (original) A hub according to claim 58, wherein:

N is chosen such that KN is a desired value.

60. (original) A hub according to claim 59, wherein:

KN is chosen to be at least 50.

61. (original) A hub according to claim 58, wherein:

said means for utilizing said data includes means for generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

62. (original) A hub according to claim 61, wherein:

said means for generating an indication includes means for estimating phase shift for each carrier group according to $\mathrm{Sin}\phi = [X_rY_0 - Y_rX_0]/A$, and $\mathrm{Cos}\phi = [X_rX_0 + Y_rY_0]/A$ where ϕ is said phase shift, and $A = A_0*[(X_r)^2 + (Y_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

63. (original) A hub according to claim 62, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

64. (original) A hub according to claim 47, wherein:

said means for utilizing said data includes means for reducing said differential quadrature components to obtain reduced differential components dY_{rkn} according to $dY_{rkn} = (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

65. (original) A hub according to claim 64, wherein:

said means for utilizing said data includes means for accumulating signs of the reduced components for each said carrier group.

66. (original) A hub according to claim 65, wherein:

said means for accumulating signs accumulates said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\,(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and

its sign determines a direction for frequency offset adjustment.

67. (original) A hub according to claim 66, wherein:

N is chosen such that KN is a desired value.

6~~9~~8. (currently amended) A hub according to claim 67, wherein:

KN is chosen to be at least 50.

69. (currently amended) A hub according to claim 6~~8~~6, wherein:

said means for utilizing said data further includes means for comparing said D_{+-} to a predetermined threshold value T_d.

70. (original) A hub according to claim 69, wherein:

said means for utilizing said data includes means for determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

71. (original) A hub according to claim 69, wherein:

said means for utilizing said data includes means for determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\ [\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\ (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})].$$

72. (original) A hub according to claim 46, wherein:

said means for utilizing said data includes means for reducing said quadrature components to obtain reduced quadrature components Y_{rkn} according to $Y_{rkn} = (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

73. (original) A hub according to claim 72, wherein:

said means for utilizing said data includes means for accumulating signs of the reduced components for each said carrier group.

74. (original) A hub according to claim 73, wherein:

said means for accumulating signs accumulates said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N}$ Sign $(Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and its sign determines a direction for frequency offset adjustment.

75. (original) A hub according to claim 74, wherein:

N is chosen such that KN is a desired value.

76. (original) A hub according to claim 75, wherein:

KN is chosen to be at least 50.

77. (original) A hub according to claim 72, wherein:

said means for utilizing said data further includes means for comparing said D_{+-} to a predetermined threshold value T_d.

78. (original) A hub according to claim 77, wherein:

said means for utilizing said data includes means for determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

79. (original) A hub according to claim 77, wherein:

said means for utilizing said data includes means for determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\left[\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\,(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})\right].$$

80. (currently amended) A hub ~~according to claim 44~~ for an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system, comprising:

a hub receiver for receiving data from a plurality of nodes with each node sending said data over a unique group of carriers at the same time; and

a hub transmitter for sending a separate frequency offset estimation for each node, wherein[[:]]

said hub includes means for utilizing said data to derive each said separate frequency offset estimation,

said hub receiver receives data from at least two nodes which utilize at least one same carrier at different times, wherein said means for utilizing said data derives a separate frequency offset estimation for each of said at least two nodes which utilize at least one same carrier at different times, and

said hub transmitter sends separate frequency offset estimation for said at least two nodes which utilize at least one same carrier at different times.

81. (canceled)

82. (currently amended) A node ~~according to claim 81~~ for an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system having a hub and a plurality of other nodes, the node comprising:

a node receiver which receives a function of an indication of a frequency offset estimation from the hub, the hub having generated the indication of a frequency offset estimation for said node receiver as a function of data received from said node and from the plurality of other nodes; and

a node transmitter for transmitting modulated corrected signals over at least one carrier, said node transmitter having an inverse fast Fourier transform (IFFT), a signal correction means coupled to said IFFT for frequency offset compensation of data signals applied to and processed by said IFFT, and a modulator coupled to said signal correction means for modulating signals corrected by said signal correction means, wherein[[:]]

said signal correction means corrects a data signal according to $X_{mc} = X_m\cos(m\phi) + Y_m\sin(m\phi)$, $Y_{mc} = Y_m\cos(m\phi)$ -

$X_m \sin(m\phi)$, where X_m and Y_m are respectively real and imaginary parts of an m-th complex sample of said signal at an output of said IFFT after processing by said IFFT, where m is an integer changing from 1 to M, and M is the number of carriers in the multicarrier system, X_{mc} and Y_{mc} are respectively real and imaginary parts of the m-th corrected sample, and ϕ is said function of said indication of said frequency offset estimation sent by the hub to said node.

83. (original) A node according to claim 82, wherein:

said node transmitter includes means for calculating a product $m\phi$ and a table which provides $\cos(m\phi)$ and $\sin(m\phi)$ values to said signal correction means in response to said means for calculating a product $m\phi$.

84. (currently amended) A node ~~according to claim 81~~ for an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system having a hub and a plurality of other nodes, the node comprising:

a node receiver which receives a function of an indication of a frequency offset estimation from the hub, the

hub having generated the indication of a frequency offset estimation for said node receiver as a function of data received from said node and from the plurality of other nodes; and

a node transmitter for transmitting modulated corrected signals over at least one carrier, said node transmitter having an inverse fast Fourier transform (IFFT), a signal correction means coupled to said IFFT for frequency offset compensation of data signals applied to and processed by said IFFT, and a modulator coupled to said signal correction means for modulating signals corrected by said signal correction means, wherein[[:]]

said indication of said frequency offset estimation sent by the hub to said node is one of phase ϕ and a function of a change in frequency Δf where $\phi = 2\pi\Delta fT$ and where T is a time interval.

85. (canceled)

86. (canceled)

87. (currently amended) A method ~~according to claim 86~~ for implementing frequency offset compensation in an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system having a hub and a plurality of nodes, where each respective node transmits data over a unique group of carriers at the same time as the other nodes, said method comprising:

a) in the hub, estimating frequency offset in the frequency domain for each group of carriers;

b) transmitting frequency offset parameters for each group of carriers from the hub to the nodes; and

c) in each node transmitter using said frequency offset parameters to implement frequency offset compensation in the time domain, wherein [[:]]

said estimating frequency offset comprises utilizing a fast Fourier transform (FFT) to convert data transmitted by the node transmitters over the carriers and received by the hub into a frequency domain, and conducting said estimating in the frequency domain, and

said estimating comprises determining quadrature components X_{dkn} and Y_{dkn} of a decision vector from received vector outputs X_{kn}, Y_{kn} of the FFT, where n is an index of OFDM symbols and k is an index of the carriers.

88. (original) A method according to claim 87, wherein:

said estimating further comprises calculating differential quadrature components dX_{kn}, dY_{kn} where $dX_{kn} = (X_{kn} - X_{dkn})$ and $dY_{kn} = (Y_{kn} - Y_{dkn})$.

89. (original) A method according to claim 88, wherein:

said estimating further comprises reducing said differential quadrature components to obtain reduced differential components dX_{rkn} and dY_{rkn} according to

$dX_{rkn} = (A_0/A_{kn})(dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})$, and

$dY_{rkn} = (A_0/A_{kn})(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$,

where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

90. (currently amended) A method according to claim 89, wherein:

said estimating further comprises averaging reduced differential components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$dX_r = (1/KN)\sum dX_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (dX_{kn}\cos\Delta_{kn} - dY_{kn}\sin\Delta_{kn})/A_k$$

$$dY_r = (1/KN)\sum dY_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

91. (original) A method according to claim 90, wherein:

N is chosen such that KN is a desired value.

92. (original) A method according to claim 91, wherein:

KN is chosen to be at least 50.

93. (original) A method according to claim 90, wherein:

said estimation includes generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

94. (original) A method according to claim 93, wherein:

said generating an indication includes means for estimating phase shift for each carrier group according to $\sin\phi = [dX_rY_0 - dY_rX_0]/A$, and $\cos\phi = [(A_0)^2 + dX_rX_0 + dY_rY_0]/A$ where ϕ is said phase shift, and $A = A_0*[(X_0+dX_r)^2 + (Y_0+dY_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

95. (original) A method according to claim 94, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

96. (original) A method according to claim 94, wherein:

said indication is a function of $\sin\phi$ and $\cos\phi$.

97. (currently amended) A method according to claim ~~8~~9̲6, wherein:

said indication is one of ϕ and Δf where $\Delta f = \phi/2\pi T$.

98. (original) A method according to claim 87, wherein:

said estimating further comprises reducing said quadrature components to obtain reduced quadrature components dX_{rkn} and dY_{rkn} according to $X_{rkn} = (A_0/A_{kn})(X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})$,

$$Y_{rkn} = (A_0/A_{kn})(Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$$

where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector, A_{kn} is an amplitude of said decision vector for the n-th symbol of the k-th carrier, and A_0 is an amplitude of said reference vector.

99. (currently amended) A method according to claim 98, wherein:

said estimating further comprises averaging reduced quadrature components by carrier group ~~according~~ to obtain group averages dX_r and dY_r according to

$$X_r = (1/KN)\sum X_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (X_{kn}\cos\Delta_{kn} - Y_{kn}\sin\Delta_{kn})/A_{kn}$$

$$Y_r = (1/KN)\sum Y_{rkn} = (A_0/KN)\sum_{k=1}^{K}\sum_{n=1}^{N} (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})/A_{kn}$$

where K is the number of carriers in a respective carrier group, and N is the number of symbols over which averaging is done.

100. (original) A method according to claim 99, wherein:

N is chosen such that KN is a desired value.

101. (original) A method according to claim 100, wherein:

KN is chosen to be at least 50.

102. (original) A method according to claim 99, wherein:

said estimating further comprises generating an indication of frequency offset for each carrier group based on said group average for said respective carrier group.

103. (original) A method according to claim 102, wherein:

said generating an indication includes estimating phase shift for each carrier group according to $\mathrm{Sin}\phi = [X_r Y_0 - Y_r X_0]/A$, and $\mathrm{Cos}\phi = [X_r X_0 + Y_r Y_0]/A$ where ϕ is said phase shift, and $A = A_0 * [(X_r)^2 + (Y_r)^2]^{0.5}$ where X_0 and Y_0 are coordinates of said reference vector.

104. (original) A method according to claim 103, wherein:

said reference vector is chosen such that $X_0=1$ and $Y_0=0$.

105. (original) A method according to claim 88, wherein:

said estimating further comprises reducing said differential quadrature components to obtain reduced differential components dY_{rkn} according to $dY_{rkn} = (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

106. (original) A method according to claim 105, wherein:

said estimating further comprises accumulating signs of the reduced components for each said carrier group.

107. (original) A method according to claim 106, wherein:

said accumulating signs comprises accumulating said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\,(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and its sign determines a direction for frequency offset adjustment.

108. (original) A method according to claim 107, wherein:

N is chosen such that KN is a desired value.

109. (original) A method according to claim 108, wherein:

KN is chosen to be at least 50.

110. (original) A method according to claim 107, wherein:

said estimating further includes comparing said D_{+-} to a predetermined threshold value T_d.

111. (original) A method according to claim 110, wherein:

said estimating includes determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

112. (original) A method according to claim 110, wherein:

said estimating includes determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\left[\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\,(dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})\right].$$

113. (currently amended) A method ~~according to claim 86~~ for implementing frequency offset compensation in an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system having a hub and a plurality of nodes, where each respective node transmits data over a unique group of carriers at the same time as the other nodes, said method comprising:

a) in the hub, estimating frequency offset in the frequency domain for each group of carriers;

b) transmitting frequency offset parameters for each group of carriers from the hub to the nodes; and

c) in each node transmitter using said frequency offset parameters to implement frequency offset compensation in the time domain, wherein[[:]]

said estimating frequency offset comprises utilizing a fast Fourier transform (FFT) to convert data transmitted by the node transmitters over the carriers and received by the hub into a frequency domain, and conducting said estimating in the frequency domain, and

said estimating further comprises reducing said quadrature components to obtain reduced quadrature components Y_{rkn} according to $Y_{rkn} = (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where Δ_{kn} is a phase difference between said decision vector for the n-th symbol of the k-th carrier and a reference vector.

114. (original) A method according to claim 113, wherein:

said estimating includes accumulating signs of the reduced components for each said carrier group.

115. (original) A method according to claim 114, wherein:

said accumulating signs comprises accumulating said signs according to $D_{+-} = \sum_{k=1}^{K}\sum_{n=1}^{N} \text{Sign}\ (Y_{kn}\cos\Delta_{kn} + X_{kn}\sin\Delta_{kn})$, where K is the number of carriers in a respective carrier group, N is the number of symbols over which averaging is done, Sign(x) = +1 or -1, and D_{+-} represents a difference between a number of components with positive phase shifts and a number of components with negative phase shifts in a carrier group and its sign determines a direction for frequency offset adjustment.

116. (original) A method according to claim 115, wherein:

N is chosen such that KN is a desired value.

117. (original) A method according to claim 116, wherein:

KN is chosen to be at least 50.

118. (original) A method according to claim 113, wherein:

said estimating includes comparing said D_{+-} to a predetermined threshold value T_d.

119. (original) A method according to claim 118, wherein:

said estimating includes determining a frequency offset value for each carrier group as a function of an average offset of the majority components of that carrier group.

120. (original) A method according to claim 118, wherein:

said estimating includes determining an adjustment direction Sign(ϕ) according to

$$\mathrm{Sign}(\phi) = \mathrm{Sign}\ [\sum_{k=1}^{K}\sum_{n=1}^{N} \mathrm{Sign}\ (dY_{kn}\cos\Delta_{kn} + dX_{kn}\sin\Delta_{kn})].$$

121. (canceled)

122. (canceled)

123. (canceled)

124. (currently amended) A method ~~according to claim 123~~ <u>for implementing frequency offset compensation in an orthogonal frequency division multiplexing (OFDM) multipoint-to-point multicarrier wireless telecommunications system having a hub and a plurality of nodes, where each respective node transmits</u>

data over a unique group of carriers at the same time as the other nodes, said method comprising:

a) in the hub, estimating frequency offset in the frequency domain for each group of carriers;

b) transmitting frequency offset parameters for each group of carriers from the hub to the nodes; and

c) in each node transmitter using said frequency offset parameters to implement frequency offset compensation in the time domain, wherein[[:]]

said using said frequency offset parameters to implement frequency offset compensation in the time domain comprises utilizing an inverse fast Fourier transform (IFFT) and a signal correction means coupled to the IFFT in each node for frequency offset compensation of data signals applied to and processed by the FFT, and

said signal correction means corrects a data signal according to $X_{mc} = X_m\cos(m\phi) + Y_m\sin(m\phi)$, $Y_{mc} = Y_m\cos(m\phi) - X_m\sin(m\phi)$, where X_m and Y_m are respectively real and imaginary parts of an m-th complex sample of said signal at an output of said IFFT after processing by said IFFT, where m is an integer changing from 1 to M, and M is the number of carriers in said multicarrier system, X_{mc} and Y_{mc} are respectively real and

imaginary parts of the m-th corrected sample, and ϕ is a function of said indication of said frequency offset estimation sent by the hub to the node.

125. (canceled)